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AN EVALUATION OF A VARIABLE CAM TIMING TECHNIQUE AS A CONTROL METHOD FOR OXIDES OF NITROGEN

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16. Abstracts

A device to allow internal exhaust gas recirculation through variable camshaft timing was tested to determine its effects on exhaust emissions. This device made use of a vacuum diaphragm and associated circuits to vary the position of the camshaft in relation to the crankshaft as a function of engine load and speed. The vehicle used was a 1970 Plymouth Fury with a 383 cu. in. engine and automatic transmission. The following tests were conducted: (1) the 1970 Federal emission test procedure as used for certification of new motor vehicles (7-mode); (2) a closed, constant volume sampling technique using nine repeats of the Federal emission test cycle (9-CVS); (3) a closed, constant volume sampling technique using the LA4-S3 driving schedule as specified for 1972 and later. The following conclusions were drawn from the results: (1) the variable cam timing device shows improvements in oxides of nitrogen; (2) the use of this device would not meet 1973 emission levels except for oxides of nitrogen; (3) this system appears to be more effective than external exhaust gas recirculation for oxides of nitrogen control.

17. Key Words and Document Analysis. 17a. Descriptors

Air pollution
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Exhaust emissions
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Exhaust gases
Circulation
Carbon monoxide
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17b. Identifiers/Open-Ended Terms

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Constant Volume Sampling Technique (9-CVS)
LA4-S3 Driving Schedule

17c. COSATI Field/Group 13B

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Device Tested

A device to allow internal exhaust gas recirculation through variable camshaft timing was tested to determine its effects on exhaust emissions. This device made use of a vacuum diaphragm and associated circuits to vary the position of the camshaft in relation to the crankshaft as a function of engine load and speed. The purpose of this device is to increase the amount of residual exhaust in the cylinder to lower oxides of nitrogen. The effect hoped for would be similar to the external exhaust gas recirculation systems currently under investigation. The vehicle used was a 1970 Plymouth Fury with a 383 cubic inch engine and automatic transmission. A more complete description of the system can be found in a Society of Automotive Engineers paper number 700673 titled "Variable Cam Timing as an Emission Control Tool".

Test Procedure

The following tests were conducted:

1. The 1970 Federal emission test procedure as used for certification of new motor vehicles (7-mode).

2. A closed, constant volume sampling technique using nine repeats of the Federal emission test cycle (9-CVS).

3. A closed, constant volume sampling technique using the LA4-S3 driving schedule as specified for 1972 and later testing (LA4).

The closed cycle data were taken using a constant volume sampling technique yielding "true mass" emission results. The bag samples were analyzed using non-dispersive infrared analyzers for carbon monoxide and carbon dioxide with hydrocarbons measured using a flame ionization detector. An electrochemical technique was used for determination of oxides of nitrogen in the CVS sample.

Emission Results

The data shown in Table I compares the results found on this system on the three emission cycles used. These tests cover the complete range of emission measuring techniques and give a good insight into the effect of this device. Table II compares the 1970 results expressed in parts per million HC and NO_x and percent CO from the variable timing technique with some results taken on similar cars using external exhaust gas recirculation. The exhaust recirculation

vehicles were 1969 full sized cars and the results are an average of four cars at a comparable mileage. From this data, it would appear that variable cam timing has a beneficial effect on the control of oxides of nitrogen without increasing emission of hydrocarbons or carbon monoxide.

Conclusions

1. The variable cam timing device shows improvements in oxides of nitrogen.

2. The use of this device alone would not meet 1973 emission levels except for oxides of nitrogen.

3. This system appears to be more effective than external exhaust gas recirculation for oxides of nitrogen control.

Table I

Emission Results
(all numbers reported in grams per mile)

	7-mode	9-CVS	LA4
HC	1.9	4.5	4.3
CO	18	49	49
CO_2	---	735	810
NOx	1.7	2.2	1.9

Table II

Emission Comparison of Internal versus External
Exhaust Recirculation Techniques
(all tests using 1970 procedure)

	Variable Cam Timing	Exhaust Recirculation
HC ppm	140 ppm	320 ppm
CO %	.66 %	1.4 %
NOx ppm	400 ppm	800 ppm